APPENDIX F

APPENDIX F-1

SWMU-SPECIFIC UNCERTAINTIES

Appendix F

F.1 Uncertainties Discussion

There is some uncertainty in not quantifying the potential risks and hazards associated with constituents that had detection limits, but not detections, that exceeded industrial RBCs (Sections 4.2.3.1, 4.3.3.1, 4.4.3.1, 4.5.3.1, and 4.6.3.1). To evaluate the issue of detection limits further, the following sections present the frequency of detection limit exceedences for each of the SWMU Group constituents that had detection limit exceedences. In addition, statistical information (such as arithmetic mean data for nondetect constituents) has been added for some of the SWMUs per a request from USEPA. It should be noted that both (1) the number of samples with detection limits that exceed the RBC and (2) the number of samples with one-half of the detection limit that exceed the RBC are presented for the 0-5 foot soil data set. The use of one-half detection limit information in these sections is important because risk assessments typically use one-half of the analytical detection limit when calculating exposure point concentrations.

F.1.1 SWMU Group A

For SWMU Group A, seven constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, indeno(1,2,3-cd)pyrene, and o,p-toluidine) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU Group A exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency Using Detection Limits	Exceedence Frequency Using 1/2-Detection Limits
3,3-dichlorobenzidine	12.7	26	9	1	34.6%	3.8%
Benzo(a)anthracene	7.84	26	1	0	3.8%	0.0%
Benzo(a)pyrene	0.784	26	10	10	38.5%	38.5%
Benzo(b)fluoranthene	7.84	26	1	0	3.8%	0.0%
Bis(2-chloroethyl)ether	5.2	26	1	1	3.8%	3.8%
Indeno(1,2,3-cd)pyrene	7.84	26	1	0	3.8%	0.0%
o,p-toluidine	30	26	1	0	3.8%	0.0%

As can be seen in the table above, benzo[a]pyrene has significantly more than 10 to 15 percent of its samples with 1/2 detection limits that exceed the RBC. Thus, if this constituent were present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentrations could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not this constituent is actually present at elevated levels at SWMU Group A, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

F.1.2   SWMU Group B

For SWMU Group B, nine constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, indeno(1,2,3-cd)pyrene, 1,2-dibromo-3-chloropropane, m-toluidine and o,p-toluidine) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU Group B exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency	
					Using Detection Limits	Using 1/2-Detection Limits
3,3-dichlorobenzidine	12.7	23	18	4	78.3%	17.4%
Benzo(a)anthracene	7.84	23	3	1	13.0%	4.3%
Benzo(a)pyrene	0.784	23	18	18	78.3%	78.3%
Benzo(b)fluoranthene	7.84	23	3	1	13.0%	4.3%
Bis(2-chloroethyl)ether	5.2	23	3	3	13.0%	13.0%
Indeno(1,2,3-cd)pyrene	7.84	23	3	1	13.0%	4.3%
1,2-dibromo-3-chloropropane	4.1	32	1	0	3.1%	0.0%
m-toluidine	30	23	1	0	4.3%	0.0%
o,p-toluidine	30	23	3	2	13.0%	8.7%

As can be seen in the table above, benzo[a]pyrene has significantly more than 10 to 15 percent of its samples with 1/2 detection limits that exceed the RBC. Thus, if this constituent were present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentration could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not this constituent is actually present at elevated levels at SWMU Group B, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

At the request of USEPA, a statistical analysis of the detection limits for constituents of potential concern was performed based on the findings of the 0-2 ft bgs and 0-5 ft bgs soil screening tables. These analyses included mean, median, maximum, minimum, standard deviation, and industrial RBC values for non-detected constituents. An evaluation indicated that the mean detection limits for most of the constituents in the 0-2 ft bgs screening table were two to three times the industrial RBCs, with the exception of benzidine that showed much greater excursions above the RBC. This indicates that the detection limits are elevated or the RBCs are relatively low. It should be noted that benzidine is not found anywhere onsite and is not believed to have been used on the site. Based on the findings of the statistical analysis, USEPA indicated in a conference call on August 14, 2000 that the detection limits did not appear very elevated, were not atypical for the classes of constituents evaluated, and did not indicate poor laboratory work. USEPA indicated they were satisfied with what had been presented in the statistical analysis of detection limits, and that there was not a problem with the non-detected data and the detection limits. USEPA also indicated that the analysis of detection limits for SWMU Group B non-detected constituents should suffice for discussions of the remaining SWMUs.

F.1.3   SWMU Group C

For SWMU Group C, seven constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, indeno(1,2,3-cd)pyrene, and o,p-toluidine) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU Group C exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency	
					Using Detection Limits	Using 1/2-Detection Limits
3,3-dichlorobenzidine	12.7	28	22	3	78.6%	10.7%
Benzo(a)anthracene	7.84	28	2	0	7.1%	0.0%
Benzo(a)pyrene	0.784	28	24	24	85.7%	85.7%
Benzo(b)fluoranthene	7.84	28	2	0	7.1%	0.0%
Bis(2-chloroethyl)ether	5.2	28	2	2	7.1%	7.1%
Indeno(1,2,3-cd)pyrene	7.84	28	2	1	7.1%	3.6%
o,p-toluidine	30	28	1	0	3.6%	0.0%

As can be seen in the table above, one constituent (benzo[a]pyrene) has significantly more than 10 to 15 percent of its samples with 1/2 detection limits that exceed the RBC. Thus, if this constituent was present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentrations could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not this constituent is actually present at SWMU Group C, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

F.1.4   SWMU Group D

For SWMU Group D, six constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, and indeno(1,2,3-cd)pyrene) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU Group D exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency	
					Using Detection Limits	Using 1/2-Detection Limits
3,3-dichlorobenzidine	12.7	56	21	5	37.5%	8.9%
Benzo(a)anthracene	7.84	56	5	2	8.9%	3.6%
Benzo(a)pyrene	0.784	56	24	21	42.9%	37.5%
Benzo(b)fluoranthene	7.84	56	5	0	8.9%	0.0%
Bis(2-chloroethyl)ether	5.2	56	5	5	8.9%	8.9%
Indeno(1,2,3-cd)pyrene	7.84	56	5	0	8.9%	0.0%

As can be seen in the table above, one constituent (benzo[a]pyrene) has significantly more than 10 to 15 percent of its samples with 1/2 detection limits that exceed the RBC. Thus, if this constituent was present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentrations could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not this constituent is actually present at SWMU Group D, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

At the request of USEPA, a statistical analysis of the detection limits for constituents of potential concern was performed based on the findings of the 0-2 ft bgs and 0-5 ft bgs soil screening tables. These analyses included mean, median, maximum, minimum, standard deviation, and industrial RBC values for non-detected constituents. An evaluation indicated that four constituents had both a median and mean concentration above the industrial RBC (e.g., 1,2-dibromoethane, 2,4-TDA, benzidine, and n-nitrosodimethylamine), whereas three constituents had a mean, but not a median concentration above the industrial RBC (e.g., benzo[a]pyrene, dibenzo[a,h]anthracene, and n-nitrosodipropylamine). This indicates that the detection limits are elevated or the RBCs are relatively low. It should be noted that benzidine is not found anywhere onsite and is not believed to have been used on the site. Based on the findings of the statistical analysis, USEPA indicated in a conference call on September 6, 2000 that the detection limits did not appear very elevated, were not atypical for the classes of constituents evaluated, and did not indicate poor laboratory work. USEPA indicated they were satisfied with what had been presented in the statistical analysis of detection limits, and that there was not a problem with the non-detected data and the detection limits.

F.1.5   SWMU 21

For SWMU 21, eight constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, indeno(1,2,3-cd)pyrene, n-nitroso-dibutylamine, and o,p-toluidine) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU 21 exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency	
					Using Detection Limits	Using 1/2-Detection Limits
3,3-dichlorobenzodine	12.7	8	3	3	37.5%	37.5%
Benzo(a)anthracene	7.84	8	3	1	37.5%	12.5%
Benzo(a)pyrene	0.784	8	4	4	50.0%	50.0%
Benzo(b)fluoranthene	7.84	8	3	1	37.5%	12.5%
Bis(2-chloroethyl)ether	5.2	8	3	1	37.5%	12.5%
Indeno(1,2,3-cd)pyrene	7.84	8	3	1	37.5%	12.5%
N-nitroso-dibutylamine	1.1	8	4	3	50.0%	37.5%
o,p-toluidine	30	8	3	1	37.5%	12.5%

As can be seen in the table above, two constituents (benzo[a]pyrene and n-nitroso-dibutylamine) have significantly more than 10 percent of their samples with 1/2 detection limits that exceed the RBC. Thus, if these constituents were present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentrations could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not these constituents are actually present at SWMU 21, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

F.1.6   SWMU 27

For SWMU 27, eight constituents (3,3-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, indeno(1,2,3-cd)pyrene, n-nitroso-dibutylamine, and o,p-toluidine) were detected at least once in site-wide soils at any depth, and some of their detection limits at SWMU Group B exceeded their respective Region III industrial RBCs. These constituents are evaluated in the following table.

Constituent	Industrial RBC (mg/kg)	Sample Size	Number of Detection Limits That Exceed RBC	Number of 1/2-Detection Limits That Exceed RBC	Exceedence Frequency	
					Using Detection Limits	Using 1/2-Detection Limits
3,3-dichlorobenzodine	12.7	24	11	6	45.8%	25.0%
Benzo(a)anthracene	7.84	24	5	5	20.8%	20.8%
Benzo(a)pyrene	0.784	24	14	11	58.3%	45.8%
Benzo(b)fluoranthene	7.84	24	5	5	20.8%	20.8%
Bis(2-chloroethyl)ether	5.2	24	5	5	20.8%	20.8%
Indeno(1,2,3-cd)pyrene	7.84	24	5	5	20.8%	20.8%
N-nitroso-dibutylamine	1.1	24	14	10	58.3%	41.7%
o,p-toluidine	30	24	5	5	20.8%	20.8%

As can be seen in the table above, two constituents (benzo[a]pyrene and n-nitroso-dibutylamine) have significantly more than 10 percent of their samples with 1/2 detection limits that exceed the RBC. Thus, if these constituents were present at one-half of the detection limit in each sample, it is possible that the resulting exposure point concentrations could be associated with an unacceptable risk or hazard for either of the two receptors. However, it is not known whether or not these constituents are actually present at SWMU 27, and it is reasonable to assume that the conservatisms inherent in the risk assessment process compensate for the uncertainties discussed herein.

F.1.7   Uncertainty Conclusions

Only one constituent (benzo[a]pyrene) consistently shows up in each SWMU group with more than 10 to 15 percent of the sample detection limits exceeding twice the industrial RBC (or stated another way, with more than 10 to 15 percent of 1/2 of the detection limits exceeding the industrial RBC). This finding is primarily related to the very low RBC threshold of 0.784 mg/kg. To get some idea of the probability of benzo(a)pyrene actually being present at any of the five SWMUs, site-wide data on this PAH were compiled. Out of approximately 600 site-wide samples for benzo(a)pyrene, this PAH was detected fourteen times, resulting in a site-wide frequency of occurrence of about 2 percent. The highest detection was 22.7 mg/kg at sample SM006-TB03-1719. The next highest detection was at 14.9 mg/kg at sample SM007-TB03-1315. Neither of these two samples are within the 0-5 foot depth interval. Out of the fourteen site-wide benzo(a)pyrene detections, only 6 exceeded the industrial RBC (i.e., less than 2 percent of the samples). This suggests benzo(a)pyrene is not very common at the site, and would not be expected at any of the SWMU Groups. It should also be noted that benzo(a)pyrene is generally ubiquitous in the environment at low concentrations, with typical background concentrations as follows (from ATSDR, 1995):

•	Rural Soils	0.002 – 1.3 mg/kg
•	Agricultural Soils	0.0046 – 0.9 mg/kg
•	Urban Soils	0.165 – 0.22 mg/kg

These findings suggest that benzo(a)pyrene's detection limit exceedences are not necessarily a significant problem at SWMU Groups A, B, C, D, and E.

Another constituent, 3,3-dichlorobenzidine, had detection limits exceeding twice the industrial RBC at a frequency of more than 15 percent in samples from SWMU Groups B and E. The constituent, 3,3-dichlorobenzidine, was detected extremely infrequently site-wide. It was detected in only one sample (SM-019-TB02-1820) out of approximately 600 total samples, at a concentration of 15.1 mg/kg. The positive detection was not in the 0 to 5 feet zone. This low detection frequency (less than one percent) strongly suggests that 3,3-dichlorobenzidine is not present at these SWMUs, and the detection limit exceedences are not a significant concern.

APPENDIX F-2

SITE-SPECIFIC SOIL SCREENING LEVELS

F.2. CALCULATION OF SITE-SPECIFIC SOIL SCREENING LEVELS

The development of site-specific SSLs is a two-step process. The first step is to estimate the relationship (partitioning) between the concentration of the constituent in soil and in groundwater. The second step is to estimate the change in groundwater concentration (attenuation) that occurs between the source area and the receptor location.

F.2.1   SOIL-WATER PARTITIONING STEP

The equation used to calculate the SSL as a function of the water concentration (based on linear partitioning from soil to groundwater) is the following (USEPA, 1996b):

$$SSL = C_w \left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b} \right) DAF$$

where:

SSL	=	soil screening level (mg/kg)
C_w	=	target concentration in groundwater (mg/L)
K_d	=	soil-water partitioning coefficient (L/kg)
θ_w	=	water-filled soil porosity (L_{water}/L_{soil})
θ_a	=	air-filled soil porosity (L_{air}/L_{soil})
H'	=	dimensionless Henry's law constant
DAF	=	dilution attenuation factor
ρ_b	=	soil bulk density (kg/L)

In accordance with USEPA guidance (USEPA, 1996b), the target concentration of each constituent in groundwater (C_w) was set equal to the federal Maximum Contaminant Level Goal (MCLG) if available and not equal to zero. If the MCLG is zero, the federal Maximum Contaminant Level (MCL) was used. If MCLs/MCLGs were not available, the USEPA Region III RBC for drinking water was used. Table F-2-1 summarizes the target groundwater concentrations for all constituents identified as being present above USEPA SSLs or having maximum detection limits exceeding the USEPA SSLs at one or more SWMUs.

The soil-water partition coefficient can be measured experimentally, estimated based on literature values for inorganic constituents, or calculated based on the soil-organic carbon partitioning coefficient (K_{oc}) and site-specific data on organic carbon as follows:

$$K_d = K_{oc} \times f_{oc}$$

where:

K_{OC}	=	soil-organic carbon partitioning coefficient (L/kg)
f_{OC}	=	fraction organic carbon (mg/mg)

For purposes of this analysis, K_d values for inorganic constituents (which are pH-specific) were obtained from USEPA SSL guidance (USEPA, 1996b; see User's Guide). For organic constituents, the above equation was used with literature values for K_{OC} and site-specific data for f_{OC}. Several soil samples at the New Martinsville facility were analyzed for total organic carbon (T_{OC}). The average T_{OC} concentration was 5,065 mg/kg, which converts to a f_{OC} value of 0.0051 mg organic carbon per mg soil.

Site-specific data were available for total soil porosity (n), soil moisture content (M), and dry soil bulk density (ρ_b). From these data, water-filled and air-filled soil porosities were calculated as follows:

$$\theta_w = M \times \rho_b$$

and

$$\theta_a = n - \theta_b$$

where:

M	=	fraction of soil moisture (= mass of soil moisture / mass dry soil)
ρ_b	=	dry soil bulk density (kg/L)
n	=	total soil porosity (L/L)

The average values for M, ρ_b, and n at the New Martinsville facility are 18.3%, 1.63 kg/L, and 0.4 L/L, respectively. Water-filled soil porosity (P_w) is estimated to be 0.3 L/L. The air-filled soil porosity (P_a) is set to 0 L/L because it is not known whether volatiles were lost during sampling (USEPA, 1996b).

The dimensionless Henry's law constant is estimated using the following formula:

$$H' = H \times 41$$

where:

H	=	Henry's law constant (atm-m^3/mol)
41	=	conversion factor

Literature values for H were used to estimate H' for constituents not listed in USEPA's (1996b) soil screening guidance.

Table F-2-2 summarizes the soil parameter values used by USEPA and the site-specific values for New Martinsville in the partitioning equation. Constituent-specific data for K_d, K_{OC}, H and H' were presented in Table F-2-1.

F.2.2 DILUTION ATTENUATION FACTOR STEP

The DAF is independent of constituents, but is dependent on many site-specific factors. The equation used by USEPA to calculate the DAF is the following (USEPA, 1996b):

$$DAF = 1 + \frac{K\,i\,d}{I\,L}$$

where:

K	=	aquifer hydraulic conductivity (m/yr)
i	=	hydraulic gradient (m/m)
d	=	mixing zone depth (m)
I	=	infiltration rate (m/yr)
L	=	source length parallel to groundwater flow (m)

Mixing zone depth (d) is estimated using the following equation:

$$d = \sqrt{2\,\alpha_v\,L} + d_a\left[1 - \exp\left(\frac{-L\,I}{V_s\,n_e\,d_a}\right)\right]$$

where:

α_v	=	vertical dispersivity (m/m)
V_s	=	horizontal seepage velocity (m/yr)
n_e	=	effective aquifer porosity ($L_{pore}/L_{aquifer}$)
d_a	=	aquifer depth (m)

If the calculated mixing zone depth exceeds the aquifer depth, then the aquifer depth was used to be conservative.

Vertical dispersivity (I_v) is estimated as follows:

$$\alpha_V = 0.056\,\alpha_L$$

and

$$\alpha_L = 0.1\,X_r$$

where:

α_L	=	longitudinal dispersivity (m/m)
X_r	=	horizontal distance to receptor (m)
0.56	=	conversion factor
0.1	=	conversion factor

The horizontal seepage velocity (V_s) is estimated as follows:

$$V_s = \frac{K\,i}{n_e}$$

The aquifer hydraulic conductivity was calculated to be 315,360 m/yr (2834 ft/day) based on the results of aquifer pump testing performed in 1985 (Geraghty & Miller, 1985; referenced in Geraghty & Miller, 1988). The average hydraulic gradient was calcuated to be 0.0012 m/m, based on data presented in the 1997 Groundwater Monitoring Information Report (ICF Kaiser, 1998).

The infiltration rate for each SWMU was estimated based on two different land uses: heavy industrial and light industrial. Heavy industrial areas are characterized as being covered by pavement, buildings, or similar features that would impede infiltration. The infiltration rate for heavy industrial SWMUs has been set to 0.03 m/yr. For light industrial areas, which may be covered by grass, gravel, or dirt, a higher infiltration rate (0.125 m/yr) was used. Each SWMU being evaluated in this analysis was identified as being "heavy" or "light"; a few had features of both land uses ("intermediate"). In these cases, the average infiltration rate of 0.0775 m/yr was used.

As indicated in the above equations, the mixing zone depth is a function of two site-specific parameters: source length parallel to groundwater flow (L) and distance to receptor (X_r). Under current conditions, groundwater flows radially inward as a result of large-scale pumping by Bayer. Under these conditions, there is no receptor to which groundwater may flow, and so no complete exposure pathways for groundwater exist. In order to calculate site-specific SSLs, two simplifying assumptions were made: (1) pumping stopped, and (2) the distance-to-receptor was set equal to the source length. Because the purpose of this analysis is to conservatively assess potential releases from soil to groundwater, these two assumptions represent hypothetical worst-case conditions.

Table F-2-3 presents the site-specific values for the aquifer parameters involved in the DAF calculation. Table F-2-4 presents the values of the parameters that are SWMU specific. The resulting DAFs are also presented in Table F-2-4. By integrating the calculations presented in this appendix, SSLs for each SWMU were calculated. These are presented in Table 3.2-2 of the report.

Constituent	Target Cw (mg/L)	Source	Koc (L/kg)	Kd (L/kg)	H (atm-m u3 /mol)	H' (--)
INORGANICS						
Antimony	0.006	MCLG	NA	see B-2	0	0
Cadmium	0.005	MCLG	NA	see B-2	0	0
Chromium	0.1	MCLG	NA	see B-2	0	0
Nickel	0.1	MCLG	NA	see B-2	0	0
ORGANICS						
1,1-Dichloroethene	0.007	MCL	58.9	0.30039	2.61E-02	1.07E+00
1,2-Dichlorobenzene	0.6	MCL	617	3.1467	1.90E-03	7.79E-02
1,4-Dichlorobenzene	0.075	MCL	617	3.1467	2.43E-03	9.96E-02
2,4-Dinitrotoluene	0.073	RBC	95.5	0.48705	9.27E-08	3.80E-06
2,6-Dinitrotoluene	0.037	RBC	69.2	0.35292	7.46E-07	3.06E-05
Benzene	0.005	MCL	58.9	0.30039	5.56E-03	2.28E-01
Benzo(a)anthracene	0.000092	RBC	398000	2029.8	3.34E-06	1.37E-04
Benzo(a)pyrene	0.0002	MCL	1020000	5202	1.13E-06	4.63E-05
Benzo(b)fluoranthene	0.000092	RBC	1230000	6273	1.11E-04	4.55E-03
bis(2-Chloroethyl)ether	0.0000092	RBC	15.5	0.07905	1.80E-05	7.38E-04
Carbon Tetrachloride	0.005	MCL	174	0.8874	3.05E-02	1.25E+00
Chlorobenzene	0.039	RBC	219	1.1169	3.71E-03	1.52E-01
cis-1,2-Dichloroethene	0.07	MCL	35.5	0.18105	4.07E-03	1.67E-01
Ethylbenzene	0.7	MCLG	363	1.8513	7.88E-03	3.23E-01
Methylene Chloride	0.005	MCL	11.7	0.05967	2.19E-03	8.98E-02
Nitrobenzene	0.0034	RBC	64.6	0.32946	2.40E-05	9.84E-04
N-Nitrosodiphenylamine	0.014	RBC	1290	6.579	5.00E-06	2.05E-04
p-Chloroaniline	0.15	RBC	66.1	0.33711	3.32E-07	1.36E-05
Phenol	22	RBC	28.8	0.14688	3.98E-07	1.63E-05
Styrene	0.1	MCLG	776	3.9576	2.76E-03	1.13E-01
Tetrachloroethene	0.005	MCL	155	0.7905	1.84E-02	7.54E-01
Toluene	1	MCLG	182	0.9282	6.63E-03	2.72E-01
Trichloroethene	0.005	MCL	166	0.8466	1.03E-02	4.22E-01
Trichlorofluoromethane	1.3	RBC	159	0.8109	5.83E-02	2.39E+00
m+p-Xylene	10	MCLG	407	2.0757	7.34E-03	3.01E-01
o-Xylene	10	MCLG	363	1.8513	5.20E-03	2.13E-01
1,1,2,2-Tetrachloroethane	0.000052	RBC	93.3	0.47583	3.44E-04	1.41E-02
1,1,2-Trichloroethane	0.003	MCLG	50.1	0.25551	9.12E-04	3.74E-02
1,1-Dichloroethene	0.007	MCLG	58.9	0.30039	2.61E-02	1.07E+00
1,2-Dichloroethane	0.005	MCL	17.4	0.08874	9.78E-04	4.01E-02
1,2-Dichloropropane	0.005	MCL	43.7	0.22287	2.80E-04	1.15E-02
Benzene	0.005	MCL	58.9	0.30039	5.56E-03	2.28E-01
Bromomethane	0.0087	RBC	10.5	0.05355	6.24E-03	2.56E-01
Carbon Tetrachloride	0.005	MCL	174	0.8874	3.05E-02	1.25E+00
cis-1,3-Dichloropropene	0.000077	RBC	45.7	0.23307	1.77E-02	7.26E-01
Methylene Chloride	0.005	RBC	11.7	0.05967	2.19E-03	8.98E-02
Tetrachloroethene	0.005	MCL	155	0.7905	1.84E-03	7.54E-02
trans-1,3-Dichloropropene	0.000077	RBC	45.7	0.23307	1.77E-02	7.26E-01
Trichloroethene	0.005	MCL	166	0.8466	1.03E-02	4.22E-01
Vinyl Chloride	0.002	MCL	18.6	0.09486	2.71E-02	1.11E+00
1,2,3-Trichlorobenzene	0.07	MCLG	1780	9.078	1.42E-03	5.82E-02
1,4-Dichlorobenzene	0.075	MCLG	617	3.1467	2.43E-03	9.96E-02
2,4,6-Trichlorophenol	0.0061	RBC	381	1.9431	7.78E-05	3.19E-03
2,4-Dichlorophenol	0.11	RBC	147	0.7497	3.17E-06	1.30E-04
2,4-Dinitrophenol	0.073	RBC	100	0.51	4.51E-06	1.85E-04
2,4-Dinitrotoluene	0.073	RBC	95.5	0.48705	9.27E-08	3.80E-06
2,6-Dinitrotoluene	0.037	RBC	69.2	0.35292	7.46E-07	3.06E-05
2-Chlorophenol	0.18	RBC	388	1.9788	3.90E-04	1.60E-02
3,3'-Dichlorobenzidine	0.00015	RBC	724	3.6924	4.00E-09	1.64E-07
Benzo(a)anthracene	0.000092	RBC	398000	2029.8	3.34E-06	1.37E-04
bis(2-chloroethyl)ether	0.0000092	RBC	15.5	0.07905	1.80E-05	7.38E-04
Carbazole	0.0034	RBC	3390	17.289	1.53E-08	6.26E-07
Hexachlorobutadiene	0.001	MCLG	53700	273.87	8.15E-03	3.34E-01
Hexachloroethane	0.00075	RBC	1780	9.078	3.88E-03	1.59E-01
Isophorone	0.071	RBC	46.8	0.23868	6.63E-06	2.72E-04
N-Nitrosodiphenylamine	0.014	RBC	1290	6.579	5.00E-06	2.05E-04
Nitrobenzene	0.0034	RBC	64.6	0.32946	2.40E-05	9.84E-04
p-Chloroaniline	0.15	RBC	66.1	0.33711	3.32E-07	1.36E-05
Pentachlorophenol	0.001	MCL	592	3.0192	2.44E-08	1.00E-06
2,4-Dimethylphenol	0.73	RBC	209	1.0659	2.00E-06	8.20E-05
Dibenzo(a,h)anthracene	0.0000092	RBC	3800000	19380	1.47E-08	6.03E-07
Hexachlorobenzene	0.001	MCL	55000	280.5	1.32E-03	5.41E-02
1,1,1-Trichloroethane	0.2	MCLG	110	0.561	1.72E-02	7.05E-01
1,2,4-Trichlorobenzene	0.07	MCLG	1780	9.078	1.42E-03	5.82E-02
Benzo(a)pyrene	0.0002	MCL	1020000	5202	1.13E-06	4.63E-05
Benzo(b)fluoranthene	0.000092	RBC	1230000	6273	1.11E-04	4.55E-03
Bromodichloromethane	0.08	MCL	55	0.2805	1.60E-03	6.56E-02
Bromoform	0.08	MCL	87.1	0.44421	5.34E-04	2.19E-02
Chloroform	0.08	MCL	39.8	0.20298	3.66E-03	1.50E-01
cis-1,2-Dichloroethene	0.07	MCLG	35.5	0.18105	4.07E-03	1.67E-01
Dibromochloromethane	0.00013	RBC	63.1	0.32181	7.83E-04	3.21E-02
Indeno(1,2,3-cd)pyrene	0.000092	RBC	3470000	17697	1.60E-06	6.56E-05
m-Toluidine	0.00035	RBC	20.8	0.10608	6.61E-08	2.71E-06
N-Nitrosodimethylamine	0.014	RBC	0.1	0.00051	1.95E-10	8.00E-09
N-Nitrosodipropylamine	0.0000096	RBC	24	0.1224	2.25E-06	9.23E-05
o-Cresol	1.8	RBC	91.2	0.46512	1.21E-06	4.95E-05
trans-1,2-Dichloroethene	0.1	MCLG	52.5	0.26775	9.39E-03	3.85E-01

Cw = target groundwater concentration
Koc = soil-organic carbon partition coefficient
Kd = soil-water partition coefficient
H, H' = Henry's Law constant

MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
RBC = USEPA Region III Risk-based Concentration
NA = not applicable

TABLE F-2-2
SOIL PARAMETERS USED IN SITE-SPECIFIC SSLs

Parameter	Units	USEPA Value u(1)	Site-specific Measurement Value	Source
water-filled soil porosity	L/L	0.3	0.3	calculated
air-filed soil porosity	L/L	0.13	0	USEPA u(2)
moisture content	%	--	18.3	Shelby tube data
total soil porosity	L/L	0.43	0.4	Shelby tube data
dry soil bulk density	kg/L	1.5	1.63	Shelby tube data
fraction organic carbon	kg/kg	0.002	0.0051	analytical data

u(1) Source: USEPA, 1996.

u(2) Air-filled soil porosity is set to zero if volatiles may have been lost during sampling (EPA, 1996).

TABLE F-2-3
AQUIFER PARAMETERS USED IN DILUTION ATTENUATION
FACTOR (DAF) CALCULATIONS

Parameter	Units	Bayer Value
hydraulic conductivity	m/yr	315360
hydraulic gradient	m/m	0.0012
infiltration rate	m/yr	
light industrial land use		0.125
heavy industrial land use		0.03
mean aquifer thickness	m	13.72
horizontal seepage velocity	m/yr	1892.16
effective aquifer porosity	L/L	0.2

Unit	Land Use	Infiltration Rate	Source Length (m)	Distance to Receptor (m)	Longitudinal Dispersivity (m/m)	Vertical Dispersivity (m/m)	Aquifer Depth (m)	Mixing Zone Depth (m)	DAF	Aquifer Depth (ft)	Scale (ft/in)	Source Length (in)	Distance to River (in)
SWMU 1	light industrial	0.125	231.6	231.6	23.2	1.30	13.72	13.72	180.31	50	80	9.5	0.125
SWMU 2	light industrial	0.125	79.2	79.2	7.9	0.44	13.72	8.41	322.39	50	80	3.25	5.5
SWMU 3	heavy industrial	0.03	12.2	12.2	1.2	0.07	13.72	1.29	1336.98	47.5	80	0.5	0.5
SWMU 4	light industrial	0.125	79.2	79.2	7.9	0.44	13.72	8.41	322.39	50	80	3.25	0.5
SWMU 5	intermediate	0.0775	146.3	146.3	14.6	0.82	13.72	13.72	458.91	45	80	6	3.75
SWMU 6	light industrial	0.125	134.1	134.1	13.4	0.75	13.72	13.72	310.72	45	80	5.5	9.5
SWMU 7	intermediate	0.0775	121.9	121.9	12.2	0.68	13.72	12.93	518.77	45	80	5	4
SWMU 8	heavy industrial	0.03	4.6	4.6	0.5	0.03	13.72	0.48	1336.98	45	80	0.1875	4
SWMU 9	intermediate	0.0775	24.4	24.4	2.4	0.14	13.72	2.59	518.77	50	80	1	7
SWMU 10	heavy industrial	0.03	841.2	841.2	84.1	4.71	13.72	13.72	206.73	50	120	23	1.5
SWMU 11	light industrial	0.125	6.1	6.1	0.6	0.03	13.72	0.65	322.40	50	80	0.25	6.5
SWMU 12	light industrial	0.125	39.6	39.6	4.0	0.22	13.72	4.21	322.40	50	80	1.625	0.25
SWMU 13	heavy industrial	0.03	978.4	978.4	97.8	5.48	13.72	13.72	177.89	50	120	26.75	3.5
SWMU 14	heavy industrial	0.03	45.7	45.7	4.6	0.26	13.72	4.84	1336.98	50	80	1.875	4
SWMU 15	light industrial	0.125	106.7	106.7	10.7	0.60	13.72	11.33	322.39	50	80	4.375	8
SWMU 16	heavy industrial	0.03	4.6	4.6	0.5	0.03	13.72	0.48	1336.98	52.5	120	0.125	6
SWMU 17	heavy industrial	0.03	20.6	20.6	2.1	0.12	13.72	2.18	1336.98	52	120	0.563	3.31
SWMU 18	heavy industrial	0.03	18.3	18.3	1.8	0.10	13.72	1.94	1336.98	25	80	0.75	16
SWMU 19	heavy industrial	0.03	9.1	9.1	0.9	0.05	13.72	0.97	1336.98	50	80	0.375	9.25
SWMU 20	light industrial	0.125	9.1	9.1	0.9	0.05	13.72	0.97	322.40	50	80	0.375	3.5
SWMU 21	light industrial	0.125	27.4	27.4	2.7	0.15	13.72	2.91	322.40	50	80	1.125	5.75
SWMU 22	light industrial	0.125	9.1	9.1	0.9	0.05	13.72	0.97	322.40	50	80	0.375	3.5
SWMU 23	heavy industrial	0.03	15.2	15.2	1.5	0.09	13.72	1.61	1336.98	47.5	80	0.625	10
SWMU 24	light industrial	0.125	9.1	9.1	0.9	0.05	13.72	0.97	322.40	45	80	0.375	10.5
SWMU 25	heavy industrial	0.03	9.1	9.1	0.9	0.05	13.72	0.97	1336.98	50	80	0.375	3.5
SWMU 26	light industrial	0.125	73.2	73.2	7.3	0.41	13.72	7.77	322.39	45	80	3	9
SWMU 27	light industrial	0.125	79.2	79.2	7.9	0.44	13.72	8.41	322.39	50	80	3.25	9.75
SWMU 28	heavy industrial	0.03	9.1	9.1	0.9	0.05	13.72	0.97	1336.98	50	120	0.25	5.5
SWMU 29	heavy industrial	0.03	73.2	73.2	7.3	0.41	13.72	7.75	1336.98	52	120	2	2.75
SWMU 30	light industrial	0.125	91.4	91.4	9.1	0.51	13.72	9.71	322.39	60	120	2.5	13.5

"Heavy industrial" refers to SWMUs covered by pavement or buildings, precluding infiltration; "light industrial" refers to
   SWMUs covered with gravel, vegetation, or dirt, where the infiltration rate would be greater.

APPENDIX F-3

RISK SPREADSHEETS

Site Name: Bayer New Martinsville

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP A

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * SA * AF * ABS * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\frac{\text{Body Dose}}{\text{ABSo}} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \frac{\text{Adj. Body Dose}}{(\text{mg/kg-day})} * \frac{\text{Cancer Slope Factor}}{(\text{mg/kg-day})^{-1}}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm^2)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

▒▒▒▒ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	11.9	2,000	1	0.100	130	70.0	25,550	1	1.73E-07	1	1.73E-07	3.2	5.54E-07	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	5.54E-07	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
  Skin surface area for hands and head.

Site Name: Bayer New Martinsville
Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP A

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \frac{\text{Body Dose}}{\text{(mg/kg-day)}} * \frac{\text{Cancer Slope Factor}}{1/\text{(mg/kg-day)}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)

AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

▓▓▓ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-toluenediamine	11.9	480	130	70.0	25,550	1	4.15E-07	1	4.15E-07	3.2	1.33E-06	NA	NA
Noncarcinogenic Effects: NA													
										SUMMATION:	1.33E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: Bayer New Martinsville

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP A

$$PEF(m^3/kg) = Q/C \times \frac{3600s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA\ (mg/m^3) = \frac{CS\ (mg/kg)}{PEF\ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) *   1/(mg/kg-day)

Hazard   = (mg/kg-day)
Index   RfD (mg/kg-day)

Body Dose
= (mg/kg-day)

WHERE:

CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)
Carcinogen Effects:														
2,4-toluenediamine	11.9	1.60E-08	2.5	8	130	70.0	25,550	1	2.62E-11	1	2.62E-11	3.2	8.39E-11	NA
Noncarcinogenic Effects: NA														
												SUMMATION:	8.39E-11	SUMMATION:

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

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Site Name: Bayer New Martinsville SWMU B

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP B

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{CS * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

$$\frac{\text{Body Dose}}{ABSo} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} * \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm²)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

▓▓▓▓▓ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	2435	2,000	1	0.100	30	70.0	25,550	1	8.17E-06	1	8.17E-06	3.2	2.61E-05	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	2.61E-05	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
                USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
                USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
       Skin surface area for hands and head.

Site Name: Bayer New Martinsville - SWMU B

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet GROUP B

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{(CS \cdot SA \cdot AF \cdot ABS \cdot EF \cdot ED \cdot CF)}{(BW \cdot AT)}$$

$$\frac{\text{Body Dose}}{ABSo} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} \cdot \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm^2)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Fraction Contacted (FC)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:																
2,4-toluenediamine	67.3	2,000	1	0.10	250	70.0	25,550	25	2.35E-05	1	0.5	2.35E-05	3.2	7.53E-05	NA	NA
Noncarcinogenic Effects: NA																
												SUMMATION:		7.53E-05	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: Bayer New Martinsville SWMU B
Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP B

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \frac{\text{Body Dose}}{\text{(mg/kg-day)}} * \frac{\text{Cancer Slope Factor}}{1/\text{(mg/kg-day)}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
   AT = AVERAGING TIME (days) = 25,550 for carcinogens
   AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

▓▓▓▓▓ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-toluenediamine	2435	480	30	70.0	25,550	1	1.96E-05	1	1.96E-05	3.2	6.27E-05	NA	NA
Noncarcinogenic Effects: NA													
										SUMMATION:	6.27E-05	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: Bayer New Martinsville - SWMU B

Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet GROUP B

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{CS \cdot IR \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$$

$$\text{Cancer Rate} = \text{Body Dose (mg/kg-day)} \cdot \text{Cancer Slope Factor } 1/(\text{mg/kg-day})$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
 AT = AVERAGING TIME (days) = 25,550 for carcinogens
 AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Fraction Contacted (FC)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:														
2,4-Toluenediamine	67.3	50	250	70.0	25,550	25	5.88E-06	1	0.5	5.88E-06	3.2	1.88E-05	NA	NA
Noncarcinogenic Effects: NA														
											SUMMATION:	1.88E-05	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

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Site Name: Bayer New Martinsville SWMU B

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet GROUP B

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA\ (mg/m^3) = \frac{CS\ (mg/kg)}{PEF\ (m^3/kg)}$$

PEF =   6.60E+08 m³/kg

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard   Body Dose
Index   = (mg/kg-day)
     RfD (mg/kg-day)

WHERE:
CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
   AT = AVERAGING TIME (days) = 25,550 for carcinogens
   AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	2435	3.69E-06	2.5	8	30	70.0	25,550	1	1.24E-09	1	1.24E-09	3.2	3.96E-09	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	3.96E-09	SUMMATION	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

Site Name: Bayer New Martinsville - SWMU B

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet GROUP B

$$PEF(m^3/kg) = Q/C \times \frac{3600s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA \ (mg/m^3) = \frac{CS \ (mg/kg)}{PEF \ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg
6.58E+08

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard   Body Dose
Index = (mg/kg-day)
          RfD (mg/kg-day)

WHERE:
CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Fraction Contacted (FC)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:																
2,4-toluenediamine	67.3	1.0197E-07	2.5	8	250	70.0	25,550	25	3.56E-09	1	0.5	3.56E-09	3.2	1.14E-08	NA	NA
Noncarcinogenic Effects: NA																
													SUMMATION:	1.14E-08	SUMMATION	NA

SOURCES:
USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

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Site Name: Bayer New Martinsville SWMU C

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{CS * SA * AF * ABS * EF * ED * CF}{BW * AT}$$

$$\frac{\text{Body Dose}}{ABSo} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} * \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm²)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

= assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	23.9	2,000	1	0.100	130	70.0	25,550	1	3.47E-07	1	3.47E-07	3.2	1.11E-06	NA	NA
Noncarcinogenic Effects:															
NA															
												SUMMATION:	1.11E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

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Site Name: Bayer New Martinsville - SWMU C

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * SA * AF * ABS * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\frac{\text{Body Dose}}{\text{ABSo}} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} * \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm^2)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	15.8	2,000	1	0.03	250	70.0	25,550	25	3.27E-06	1	3.27E-06	3.2	1.05E-05	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	1.05E-05	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
           USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
           USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
       Skin surface area for hands and head.

Site Name: Bayer New Martinsville SWMU C
Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \frac{\text{Body Dose}}{\text{(mg/kg-day)}} * \frac{\text{Cancer Slope Factor}}{1/\text{(mg/kg-day)}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

▓▓▓▓ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-toluenediamine	23.9	480	130	70.0	25,550	1	8.34E-07	1	8.34E-07	3.2	2.67E-06	NA	NA
Noncarcinogenic Effects: NA													
										SUMMATION:	2.67E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: Bayer New Martinsville - SWMU C

Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \text{Body Dose (mg/kg-day)} * \text{Cancer Slope Factor } 1/(\text{mg/kg-day})$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
    AT = AVERAGING TIME (days) = 25,550 for carcinogens
    AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-Toluenediamine	15.6	50	250	70.0	25,550	25	2.73E-06	1	2.73E-06	3.2	8.72E-06	NA	NA
Noncarcinogenic Effects: NA													
										SUMMATION:	8.72E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

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Site Name: Bayer New Martinsville SWMU C

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor:.   Construction Worker - 0-5 feet

$$PEF(m^3/kg) = Q/C \times \frac{3600s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (Inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA \ (mg/m^3) = \frac{CS \ (mg/kg)}{PEF \ (m^3/kg)}$$

PEF =   6.60E+08 m³/kg

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard   Body Dose
Index   = (mg/kg-day)
    RfD (mg/kg-day)

WHERE:
    CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
    IR = INHALATION RATE (m³/hour)
    ET = EXPOSURE TIME (hours/day)
    EF = EXPOSURE FREQUENCY (days/year)
    ED = EXPOSURE DURATION (years)

    BW = BODY WEIGHT (kg)
    AT = AVERAGING TIME (days)
        AT = AVERAGING TIME (days) = 25,550 for carcinogens
        AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	23.9	3.62E-08	2.5	8	130	70.0	25,550	1	5.26E-11	1	5.26E-11	3.2	1.68E-10	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	1.68E-10	SUMMATION	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
    USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

Site Name: Bayer New Martinsville - SWMU C

Scenario: Particulate Inhalation of Chemical Constituents in Soil
- Receptor: Industrial Worker - 0-2 feet

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA \ (mg/m^3) = \frac{CS \ (mg/kg)}{PEF \ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg
6.58E+08

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard   = (mg/kg-day) Body Dose
Index   RfD (mg/kg-day)

WHERE:
CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
    AT = AVERAGING TIME (days) = 25,550 for carcinogens
    AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	15.8	2.38364E-08	2.5	8	250	70.0	25,550	25	1.65E-09	1	1.65E-09	3.2	5.29E-09	NA	NA
Noncarcinogenic Effects:															
NA															
												SUMMATION:	5.29E-09	SUMMATION:	NA

SOURCES:
USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

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Site Name: Bayer New Martinsville SWMU D

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{CS \cdot SA \cdot AF \cdot ABS \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$$

$$\frac{\text{Body Dose}}{ABSo} = \text{Adjusted Body Dose}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} \cdot \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm^2)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED $\cdot$ 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

= assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	8.7	2,000	1	0.100	130	70.0	25,550	1	1.26E-07	1	1.26E-07	3.20E+00	4.05E-07	NA	NA
o,p-toluidine	15	2,000	1	0.100	130	70.0	25,550	1	2.18E-07	1	2.18E-07	1.90E-01	4.14E-08	NA	NA
m-toluidine	4	2,000	1	0.100	130	70.0	25,550	1	5.81E-08	1	5.81E-08	1.90E-01	1.10E-08	NA	NA
benzene	0.932	2,000	1	0.030	130	70.0	25,550	1	4.06E-09	1	4.06E-09	2.90E-02	1.18E-10	NA	NA
aniline	17.8	2,000	1	0.100	130	70.0	25,550	1	2.59E-07	1	2.59E-07	5.70E-03	1.47E-09	NA	NA
Noncarcinogenic Effects:															
benzene	0.932	2,000	1	0.030	130	70.0	365	1	2.85E-07	1	2.85E-07	NA	NA	3.00E-03	9.48E-05
aniline	17.8	2,000	1	0.100	130	70.0	365	1	1.81E-05	1	1.81E-05	NA	NA	7.00E-03	2.59E-03
												SUMMATION:	4.59E-07	SUMMATION:	2.68E-03

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
             USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
             USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
        Skin surface area for hands and head.

Site Name: Bayer New Martinsville SWMU D
Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \frac{\text{Body Dose}}{(\text{mg/kg-day})} * \frac{\text{Cancer Slope Factor}}{1/(\text{mg/kg-day})}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

▨ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-toluenediamine	8.7	480	130	70.0	25,550	1	3.04E-07	1	3.04E-07	3.20E+00	9.71E-07	NA	NA
o,p-toluidine	15	480	130	70.0	25,550	1	5.23E-07	1	5.23E-07	1.90E-01	9.94E-08	NA	NA
m-toluidine	4	480	130	70.0	25,550	1	1.40E-07	1	1.40E-07	1.90E-01	2.65E-08	NA	NA
benzene	0.932	480	130	70.0	25,550	1	3.25E-08	1	3.25E-08	2.90E-02	9.43E-10	NA	NA
aniline	17.8	480	130	70.0	25,550	1	6.21E-07	1	6.21E-07	5.70E-03	3.54E-09	NA	NA
Noncarcinogenic Effects:													
benzene	0.932	480	130	70.0	365	1	2.28E-06	1	2.28E-06	NA	NA	3.00E-03	7.59E-04
aniline	17.8	480	130	70.0	365	1	4.35E-05	1	4.35E-05	NA	NA	7.00E-03	6.21E-03
										SUMMATION: 1.10E-06		SUMMATION:	6.97E-03

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: Bayer New Martinsville - SWMU D

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA\ (mg/m^3) = \frac{CS\ (mg/kg)}{PEF\ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg
6.58E+08

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) *   1/(mg/kg-day)

Hazard = Body Dose (mg/kg-day)
Index   RfD (mg/kg-day)

WHERE:
- CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
- IR = INHALATION RATE (m³/hour)
- ET = EXPOSURE TIME (hours/day)
- EF = EXPOSURE FREQUENCY (days/year)
- ED = EXPOSURE DURATION (years)

- BW = BODY WEIGHT (kg)
- AT = AVERAGING TIME (days)
  - AT = AVERAGING TIME (days) = 25,550 for carcinogens
  - AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	8.7	1.32E-08	2.5	8	130	70.0	25,550	1	1.92E-11	1	1.92E-11	NA	NA	NA	NA
o,p-toluidine	15	2.27E-08	2.5	8	130	70.0	25,550	1	3.30E-11	1	3.30E-11	NA	NA	NA	NA
m-toluidine	4	6.06E-09	2.5	8	130	70.0	25,550	1	8.81E-12	1	8.81E-12	NA	NA	NA	NA
benzene	0.932	1.41E-09	2.5	8	130	70.0	25,550	1	2.05E-12	1	2.05E-12	2.90E-02	5.95E-14	NA	NA
aniline	17.8	2.70E-08	2.5	8	130	70.0	25,550	1	-3.92E-11	1	3.92E-11	NA	NA	NA	NA
Noncarcinogenic Effects:															
benzene	0.932	1.41E-09	2.5	8	130	70.0	365	1	1.44E-10	1	1.44E-10	NA	NA	1.70E-03	8.45E-08
aniline	17.8	2.70E-08	2.5	8	130	70.0	365	1	2.74E-09	1	2.74E-09	NA	NA	1.00E-02	2.74E-07
												SUMMATION:	5.95E-14	SUMMATION:	3.59E-07

SOURCES:
USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

Site Name: Bayer New Martinsville SWMU D

Scenario: Volatile Inhalation of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

VOLITILIZATION FACTOR (VF): CHEMICAL-SPECIFIC VALUES

Constituent	H (unitless)	Koc (cm³/g)	Kd (cm³/g)	Ea (Lair/Lsoil)	Ew (Lwater/Lsoil)	Dw (cm²/sec)	Di (cm²/sec)	Pb (g/cm³)	Da (cm²/s)	VF (m³/kg)
benzene	0.228	58.9	0.30039	0	0.3	9.80E-06	0.088	1.63E+00	1.41E-06	97190.68798

Ea (air-filled soil porosity)	0.000	Lair/Lsoil	Note 1
n (total soil porosity)	0.400	Lpore/Lsoil	Site specific
Ew (water-filled soil porosity)	0.3	Lwater/Lsoil	Site specific
Pb (dry soil bulk density)	1.63	g/cm³	Site specific
Ps (soil particle density)	2.65	g/cm³	EPA 1996 default
Di (diffusivity in air)	--	cm²/sec	chemical-specific
Henry's law constant (H¹)	--	unitless	chemical-specific
Dw (diffusivity in water)	--	cm²/sec	chemical-specific
Kd (soil-water partition coefficient)	--	cm²/g	foc x koc
Koc (soil-organic carbon partition coefficient)	--	cm²/g	chemical-specific
foc (fraction organic carbon)	0.0051	g/g	Site specific
Exposure Interval (T)	9.50E+08	sec	EPA 1996 default
Dispersion Factor (Q/C)	68.810000	(g/m²-s)/(kg/m³)	EPA 1996 default

Note 1: Air-filled soil porosity set to zero if VOCs may have been lost during sampling.

$$VF\ (m^3/kg) = Q/C \times \frac{(3.14 \times Da \times T)^{1/2}}{(2 \times Pb \times Da)} \times 10^{-4}\ (m^2/cm^2)$$

$$Da\ (cm^2/s) = \frac{(Ea^{10/3} \times DiH^1 + Ew^{10/3}Dw)/n^2}{PbKd + Ew + EaH^1}$$

$$CA\ (mg/m^3) = \frac{CS\ (mg/kg)}{VF\ (m^3/kg)}$$

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer Body Dose Cancer Slope Factor
.Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard = Body Dose (mg/kg-day)
Index RfD (mg/kg-day)

WHERE:
CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
    AT = AVERAGING TIME (days) = 25,550 for carcinogens
    AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

= assume chronic CSF or RfD

Constituent	"CS" Concentration in soil (mg/kg)	"CA" Concentration in air (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos. Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
benzene	0.932	9.6E-06	2.5	8	130	70.0	25,550	1	1.39E-08	1	1.39E-08	2.90E-02	4.04E-10	NA	NA
Noncarcinogenic Effects: NA															
benzene	0.932	9.6E-06	2.5	8	130	70.0	365	1	9.76E-07	1	9.76E-07	NA	NA	1.70E-03	5.74E-04
												SUMMATION:	4.04E-10	SUMMATION:	5.74E-04

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

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Site Name: **Bayer New Martinsville SWMU 21**

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * SA * AF * ABS * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\frac{Body\ Dose}{ABSo} = Adjusted\ Body\ Dose$$

$$Cancer\ Risk = \frac{Adj.\ Body\ Dose}{(mg/kg-day)} * Cancer\ Slope\ Factor\ (mg/kg-day)^{-1}$$

$$Hazard\ Index = \frac{Adj.\ Body\ Dose\ (mg/kg-day)}{Reference\ Dose\ (mg/kg-day)}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm^2)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

▓▓▓▓▓▓▓ = assume chronic CSF or RfD
for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamine	86.2	2,000	1	0.100	130	70.0	25,550	1	1.25E-06	1	1.25E-06	3.2	4.01E-06	NA	NA
Noncarcinogenic Effects: NA															
												SUMMATION:	4.01E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: **Bayer New Martinsville - SWMU 21**

Scenario: Dermal Contact with Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from dermal exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * SA * AF * ABS * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Body Dose} = \frac{\text{Adjusted Body Dose}}{\text{ABSo}}$$

$$\text{Cancer Risk} = \text{Adj. Body Dose (mg/kg-day)} * \text{Cancer Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Hazard Index} = \frac{\text{Adj. Body Dose (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
SA = SKIN SURFACE AREA (cm^2)
AF = SOIL-TO-SKIN ADHERENCE FACTOR (mg/cm²)
ABS = ABSORPTION FACTOR (unitless) - USEPA Region III, 1995
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days) = 25,550 for carcinogens
AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens
ABSo = ORAL ABSORPTION FACTOR (unitless)

Constituent	"CS" Concentration (mg/kg)	"SA" Skin Area (cm^2)	"AF" Adh. Factor (mg/cm2)	"ABS" Abs. Factor	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Fraction Contacted "FC"	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Dermal Cancer Risk	Reference Dose (RfD) (mg/kg-day)
Carcinogen Effects:															
2,4-toluenediamine	86.2	2,000	1	0.10	250	70.0	25,550	25	1.51E-05	0.25	1	1.51E-05	3.2	4.82E-05	NA
Noncarcinogenic Effects: NA															
												SUMMATION:		4.82E-05	SUMMATION

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: **Bayer New Martinsville SWMU 21**
Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

Body Dose = (CS * IR * EF * ED * CF)/(BW * AT)
(mg/kg-day)

$$\text{Cancer Rate} = \frac{\text{Body Dose}}{\text{(mg/kg-day)}} * \frac{\text{Cancer Slope Factor}}{1/\text{(mg/kg-day)}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR $(10^{-6}$ kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
    AT = AVERAGING TIME (days) = 25,550 for carcinogens
    AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

▓▓▓ = assume chronic CSF or RfD for subchronic exposure

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:													
2,4-toluenediamine	86.2	480	130	70.0	25,550	1	3.01E-06	1	3.01E-06	3.2	9.62E-06	NA	NA
Noncarcinogenic Effects: NA													
										SUMMATION:	9.62E-06	SUMMATION:	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
           USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
           USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
       Skin surface area for hands and head.

Site Name: **Bayer New Martinsville - SWMU 21**

Scenario: Ingestion of Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet

This table calculates estimated body dose, incremental cancer risk, and hazard indices from ingestion exposure to chemical constituents in soil.
The equations used to calculate body doses, incremental cancer risks, and hazard indices are:

$$\text{Body Dose (mg/kg-day)} = \frac{CS \cdot IR \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$$

$$\text{Cancer Rate} = \text{Body Dose (mg/kg-day)} \cdot \text{Cancer Slope Factor } 1/(\text{mg/kg-day})$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

WHERE:

CS = CONCENTRATION OF CONSTITUENT IN SOIL (mg/kg)
IR = INGESTION RATE (mg/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

CF = CONVERSION FACTOR (10^{-6} kg/mg)
BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
$\quad$ AT = AVERAGING TIME (days) = 25,550 for carcinogens
$\quad$ AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"IR" Ing Rate (mg/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Fraction Contacted "FC"	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Ingestion Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:														
2,4-Toluenediamine	86.2	50	250	70.0	25,550	25	3.77E-06	0.25	1	3.77E-06	3.2	1.20E-05	NA	NA
Noncarcinogenic Effects: NA														
										SUMMATION:		1.20E-05	SUMMATION	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.
USEPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/01-B.

NOTES: Body Dose (absorbed) converted to Adjusted Body Dose (administered) by dividing by oral absorption factor, as recommended in RAGS (USEPA, 1989) Appendix A) to allow use of CSFs and RfDs based on administered doses.
Skin surface area for hands and head.

Site Name: **Bayer New Martinsville SWMU 21**

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Construction Worker - 0-5 feet

$$PEF(m^3/kg) = Q/C \times \frac{3600s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA \ (mg/m^3) = \frac{CS \ (mg/kg)}{PEF \ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer Body Dose Cancer Slope Factor
Rate = (mg/kg-day) * 1/(mg/kg-day)

Hazard = Body Dose (mg/kg-day)
Index   RfD (mg/kg-day)

WHERE:
CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
IR = INHALATION RATE (m³/hour)
ET = EXPOSURE TIME (hours/day)
EF = EXPOSURE FREQUENCY (days/year)
ED = EXPOSURE DURATION (years)

BW = BODY WEIGHT (kg)
AT = AVERAGING TIME (days)
    AT = AVERAGING TIME (days) = 25,550 for carcinogens
    AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)-1	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:															
2,4-toluenediamino	88.2	1.31E-07	2.5	8	130	70.0	25,550	1	1.90E-10	1	1.90E-10	3.2	6.08E-10	NA	NA
Noncarcinogenic Effects:															
NA															
												SUMMATION:	6.08E-10	SUMMATION	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
            USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

Site Name: **Bayer New Martinsville - SWMU 21**

Scenario: Particulate Inhalation of Chemical Constituents in Soil
Receptor: Industrial Worker - 0-2 feet

$$PEF(m^3/kg) = Q/C \times \frac{3600s/hr}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Where:

	Value	Source
Q/C (Inverse of mean concentration at the center of the source area in g/m²-s per kg/m³)	90.8	EPA 1996 default
V (Fraction of vegetative cover)- conservatively assume no vegetative cover, unitless	0	assumed
Um (Mean annual wind speed in m/s)	4.69	EPA 1996 default
Ut (Equivalent threshold value of windspeed at 7m in m/s)	11.32	EPA 1996 default
F(x) (Function dependent on Um/Ut, derived using Cowherd (1985) - unitless)	0.194	EPA 1996 default

$$CA \ (mg/m^3) = \frac{CS \ (mg/kg)}{PEF \ (m^3/kg)}$$

PEF = 6.60E+08 m³/kg
6.58E+08

Body Dose = (CA * IR * ET * EF * ED)/(BW * AT)
(mg/kg-day)

Cancer   Body Dose   Cancer Slope Factor
Rate = (mg/kg-day) *   1/(mg/kg-day)

Hazard   = Body Dose (mg/kg-day)
Index   RfD (mg/kg-day)

WHERE:
 CA = CONCENTRATION OF CONSTITUENT IN AIR (mg/m³)
 IR = INHALATION RATE (m³/hour)
 ET = EXPOSURE TIME (hours/day)
 EF = EXPOSURE FREQUENCY (days/year)
 ED = EXPOSURE DURATION (years)

 BW = BODY WEIGHT (kg)
 AT = AVERAGING TIME (days)
  AT = AVERAGING TIME (days) = 25,550 for carcinogens
  AT = AVERAGING TIME (days) = ED * 365 days/year for noncarcinogens

Constituent	"CS" Concentration (mg/kg)	"CA" Concentration (mg/m³)	"IR" Inh Rate (m³/hour)	"ET" Expos.Time (hours/day)	"EF" Expos. Freq. (days/year)	"BW" Body Weight (kg)	"AT" Averaging Time (days)	"ED" Exp. Duration (years)	Body Dose (mg/kg-day)	Fraction Contacted "FC"	Oral Absorp. Factor (unitless)	Adjusted Body Dose (mg/kg-day)	CSF (mg/kg-day)⁻¹	Inhalation Cancer Risk	Reference Dose (RfD) (mg/kg-day)	"HI" Hazard Index
Carcinogen Effects:																
2,4-toluenediamine	88.2	1.30806E-07	2.5	8	250	70.0	25,550	25	2.28E-09	0.25	1	2.28E-09	3.2	7.30E-09	NA	NA
Noncarcinogenic Effects:																
NA																
													SUMMATION	7.30E-09	SUMMATION	NA

SOURCES: USEPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540/189/002.
USEPA, 1989, Exposure Factors Handbook, EPA/600/8-89/043.

APPENDIX F-4

CONSTITUENTS EXCEEDING RESIDENTIAL RBC

TABLE 7-1
Screening of Constituents in On-Site Groundwater (1998)

Constituent	CAS Number	Units	Frequency of Detection	Range of Detections		Sample of Maximum Detection	Benchmark Screening Levels[1]	Ref.	Maximum Detection Exceeds Benchmark
1,2-Dichlorobenzene	95-50-1	mg/l	17 - 62	0.0025	- 1.68	RW-2a (ECD# 981-15)	6.0E-01	2	Max. Det. > Bench
1,4-Dichlorobenzene	106-46-7	mg/l	5 - 62	0.00284	- 0.133	RW-2a (ECD# 981-15)	7.5E-02	2	Max. Det. > Bench
2,4-Diaminotoluene	95-80-7	mg/l	5 - 63	0.123	- 0.811	RW-1 (ECD#983-14)	2.1E-05	3	Max. Det. > Bench
2,4-Dinitrotoluene	121-14-2	mg/l	10 - 63	0.00312	- 12.5	MW-10S (ECD#981-28)	7.3E-02	3	Max. Det. > Bench
2,6-Dinitrotoluene	606-20-2	mg/l	8 - 63	0.0216	- 7.42	MW-10S (ECD#981-28)	3.7E-02	3	Max. Det. > Bench
2-Nitrotoluene	88-72-2	mg/l	10 - 63	0.00242	- 1.59	RW-3a (ECD# 981-16)	6.1E-02	3	Max. Det. > Bench
3-Nitrotoluene	99-08-1	mg/l	4 - 63	0.00618	- 0.129	RW-3a (ECD# 981-16)	1.2E-01	3	Max. Det. > Bench
4-Nitrotoluene	99-99-0	mg/l	7 - 63	0.0556	- 1.31	RW-3a (ECD# 981-16)	6.1E-02	3	Max. Det. > Bench
5-Nitro-o-toluidine	99-55-8	mg/l	6 - 63	0.00308	- 1.02	MW-10S(ECD#983-28)	2.0E-03	3	Max. Det. > Bench
Aniline	62-53-3	mg/l	5 - 63	0.0262	- 0.994	RW-2a (ECD# 981-15)	1.2E-02	3	Max. Det. > Bench
Barium	7440-39-3	mg/l	25 - 25	0.0391	- 2.27	GM-16S (ECD #981-22)	2.0E+00	2	Max. Det. > Bench
Benzene	71-43-2	mg/l	7 - 61	0.1	- 1.23	RW-2a (ECD# 981-15)	5.0E-03	2	Max. Det. > Bench
Benzoic Acid	65-85-0	mg/l	1 - 63	0.00258	- 0.00258	FP-4(ECD#983-5)	1.5E+02	3	No
bis(2-Chloroethyl)ether	111-44-4	mg/l	1 - 63	1.15	- 1.15	RW-2a (ECD# 981-15)	9.6E-06	3	Max. Det. > Bench
bis(2-Ethylhexyl) phthalate	117-81-7	mg/l	29 - 63	0.00252	- 0.0296	LF-1S (ECD#981-1)	4.8E-03	3	Max. Det. > Bench
Bisphenol A	80-05-7	mg/l	8 - 63	0.00382	- 0.0966	RW-2a (ECD# 981-15)	--		NA
Cadmium	7440-43-9	mg/l	1 - 61	0.0464	- 0.0464	MW-7S (ECD#981-26)	5.0E-03	2	Max. Det. > Bench
Calcium	7440-70-2	mg/l	24 - 24	8.73	- 244	LF-1S (ECD#981-1)	--		NA
Chlorobenzene	108-90-7	mg/l	20 - 61	0.00222	- 178	MW-10S(ECD#983-28)	1.1E-01	3	Max. Det. > Bench
cis-1,2-Dichloroethene	156-59-2	mg/l	4 - 61	0.00249	- 0.00491	LF-4D FD A (ECD983-2)	7.0E-02	2	No
Copper	7440-50-8	mg/l	12 - 25	0.00702	- 0.247	MW-7S (ECD#981-26)	1.5E+00	3	No
Diethyl phthalate	84-66-2	mg/l	3 - 63	0.00688	- 0.0276	LF-4S (ECD983-4)	2.9E+01	3	No
Di-n-butyl phthalate	84-74-2	mg/l	3 - 63	0.00268	- 0.00426	LF-4S (ECD983-4)	3.7E+00	3	No
Di-n-octyl phthalate	117-84-0	mg/l	1 - 63	0.0033	- 0.0033	LF-1S (ECD#981-1)	7.3E-01	3	No
Iron	7439-89-6	mg/l	24 - 25	0.0121	- 42.6	LF-4S (ECD#981-4)	1.1E+01	3	Max. Det. > Bench
Lead	7439-92-1	mg/l	10 - 61	0.00416	- 0.492	MW-7S (ECD#981-26)	--		NA
Magnesium	7439-95-4	mg/l	24 - 24	3.95	- 58	LF-1S (ECD#981-1)	--		NA
Manganese	7439-96-5	mg/l	25 - 25	0.02	- 44.4	LF-1S (ECD#981-1)	7.3E-01	3	Max. Det. > Bench
m-Toluidine	108-44-1	mg/l	2 - 63	0.021	- 0.021	LF-4S (ECD983-4)	--		NA
Nickel	7440-02-0	mg/l	29 - 61	0.00487	- 0.48	MW-7S (ECD#981-26)	7.3E-01	3	No
Nitrobenzene	98-95-3	mg/l	15 - 62	0.00208	- 2.8	RW-3a (ECD# 981-16)	3.5E-03	3	Max. Det. > Bench
p-Chloroaniline	106-47-8	mg/l	3 - 63	0.00516	- 0.414	LF-4S (ECD#981-4)	1.5E-01	3	Max. Det. > Bench
Phenol	108-95-2	mg/l	12 - 63	0.00122	- 0.00923	RW-1 (ECD#983-14)	2.2E+01	3	No
Potassium	7440-09-7	mg/l	23 - 24	1.28	- 119	LF-4S (ECD#981-4)	--		NA
p-Toluidine	106-49-0	mg/l	3 - 63	0.0117	- 0.244	RW-2a (ECD# 981-15)	3.5E-04	3	Max. Det. > Bench
Sodium	7440-23-5	mg/l	24 - 24	12.2	- 952	GM-5B (ECD #981-19)	--		NA
Tetrahydrofuran	109-99-9	mg/l	1 - 61	0.116	- 0.116	LF-4S (ECD#981-4)	8.8E-03	3	Max. Det. > Bench
Trichloroethene	79-01-6	mg/l	2 - 61	0.00108	- 0.00115	LF-4D FD B (ECD983-3)	5.0E-03	2	No
Zinc	7440-66-6	mg/l	18 - 25	0.00517	- 0.5	MW-7S (ECD#981-26)	1.1E+01	3	No

Notes:

(1) In lieu of Federal MCLs, Region III RBCs were used as Benchmark Screening Levels. Remanded MCLs and Federal Action Levels were not considered.

(2) Federal MCL

(3) Region III Risk-Based Concentration for Tap Water.

Only Detected Constituents are presented here.

NA = Not Applicable

" -- " = Neither a Federal MCL nor a Region III RBC were available.

Bayer Corporation
New Martinsville, WV

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TABLE 7-2
Screening of Constituents in Off-Site Groundwater (1998)

Constituent	CAS Number	Units	Frequency of Detection	Range of Detections	Sample of Maximum Detection	Benchmark Screening Level[1]	Maximum Detection Exceeds Benchmark
1,1,1,2-Tetrachloroethane	630-20-6	mg/l	0 - 4	ND		--	NA
1,1,1-Trichloroethane	71-55-6	mg/l	0 - 4	ND		--	NA
1,1,2,2-Tetrachloroethane	79-34-5	mg/l	0 - 4	ND		--	NA
1,1,2-Trichloroethane	79-00-5	mg/l	0 - 4	ND		--	NA
1,1-Dichloroethane	75-34-3	mg/l	0 - 4	ND		--	NA
1,1-Dichloroethene	75-35-4	mg/l	0 - 4	ND		--	NA
1,1-Dichloropropene	563-58-6	mg/l	0 - 4	ND		--	NA
1,2,3-Trichlorobenzene	87-61-6	mg/l	0 - 4	ND		--	NA
1,2,3-Trichloropropane	96-18-4	mg/l	0 - 4	ND		--	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	mg/l	0 - 4	ND		--	NA
1,2,4-Trichlorobenzene	120-82-1	mg/l	0 - 4	ND		--	NA
1,2,4-Trimethylbenzene	95-63-6	mg/l	0 - 4	ND		--	NA
1,2-Dibromo-3-chloropropane	96-12-8	mg/l	0 - 4	ND		--	NA
1,2-Dibromoethane	106-93-4	mg/l	0 - 4	ND		--	NA
1,2-Dichlorobenzene	95-50-1	mg/l	0 - 4	ND		--	NA
1,2-Dichloroethane	107-06-2	mg/l	0 - 4	ND		--	NA
1,2-Dichloropropane	78-87-5	mg/l	0 - 4	ND		--	NA
1,3,5-Trimethylbenzene	108-67-8	mg/l	0 - 4	ND		--	NA
1,3-Dichlorobenzene	541-73-1	mg/l	0 - 4	ND		--	NA
1,3-Dichloropropane	142-28-9	mg/l	0 - 4	ND		--	NA
1,4-Dichlorobenzene	106-46-7	mg/l	0 - 4	ND		--	NA
1-Chloronaphthalene	90-13-1	mg/l	0 - 4	ND		--	NA
1-Methylnaphthalene	90-12-0	mg/l	0 - 4	ND		--	NA
1-Naphthylamine	134-32-7	mg/l	0 - 4	ND		--	NA
2,2-Dichloropropane	590-20-7	mg/l	0 - 4	ND		--	NA
2,3,4,6-Tetrachlorophenol	58-90-2	mg/l	0 - 4	ND		--	NA
2,3-Dichloroaniline	608-27-5	mg/l	0 - 4	ND		--	NA
2,4,5-Trichlorophenol	95-95-4	mg/l	0 - 4	ND		--	NA
2,4,6-Trichlorophenol	88-06-2	mg/l	0 - 4	ND		--	NA
2,4-Diaminotoluene	95-80-7	mg/l	0 - 4	ND		--	NA
2,4-Dichlorophenol	120-83-2	mg/l	0 - 4	ND		--	NA
2,4-Dimethylphenol	105-67-9	mg/l	0 - 4	ND		--	NA
2,4-Dinitrophenol	51-28-5	mg/l	0 - 4	ND		--	NA
2,4-Dinitrotoluene	121-14-2	mg/l	0 - 4	ND		--	NA
2,6-Dichlorophenol	87-65-0	mg/l	0 - 4	ND		--	NA
2,6-Dinitrotoluene	606-20-2	mg/l	0 - 4	ND		--	NA
2-Butanone	78-93-3	mg/l	0 - 4	ND		--	NA
2-Chloroethyl vinyl ether	110-75-8	mg/l	0 - 4	ND		--	NA
2-Chloronaphthalene	91-58-7	mg/l	0 - 4	ND		--	NA
2-Chlorophenol	95-57-8	mg/l	0 - 4	ND		--	NA
2-Chlorotoluene	95-49-8	mg/l	0 - 4	ND		--	NA
2-Hexanone	591-78-6	mg/l	0 - 4	ND		--	NA
2-Methylacetonitrile	107-12-0	mg/l	0 - 4	ND		--	NA
2-Methylnaphthalene	91-57-6	mg/l	0 - 4	ND		--	NA
2-Methylpyridine	109-06-8	mg/l	0 - 4	ND		--	NA
2-Naphthylamine	91-59-8	mg/l	0 - 4	ND		--	NA
2-Nitroaniline	88-74-4	mg/l	0 - 4	ND		--	NA
2-Nitrophenol	88-75-5	mg/l	0 - 4	ND		--	NA
2-Nitropropane	79-46-9	mg/l	0 - 4	ND		--	NA
2-Nitrotoluene	88-72-2	mg/l	0 - 4	ND		--	NA
3,3'-Dichlorobenzidine	91-94-1	mg/l	0 - 4	ND		--	NA
3-Chloropropene	107-05-1	mg/l	0 - 4	ND		--	NA
3-Methylcholanthrene	56-49-5	mg/l	0 - 4	ND		--	NA
3-Nitroaniline	99-09-2	mg/l	0 - 4	ND		--	NA
3-Nitrotoluene	99-08-1	mg/l	0 - 4	ND		--	NA
4,6-Dinitro-o-cresol	534-52-1	mg/l	0 - 4	ND		--	NA
4-Aminobiphenyl	92-67-1	mg/l	0 - 4	ND		--	NA
4-Bromophenyl phenylether	101-55-3	mg/l	0 - 4	ND		--	NA
4-Chlorophenyl phenylether	7005-72-3	mg/l	0 - 4	ND		--	NA
4-Nitroaniline	100-01-6	mg/l	0 - 4	ND		--	NA
4-Nitrophenol	100-02-7	mg/l	0 - 4	ND		--	NA
4-Nitrotoluene	99-99-0	mg/l	0 - 4	ND		--	NA
5-Nitro-o-toluidine	99-55-8	mg/l	0 - 4	ND		--	NA

Bayer Corporation
New Martinsville, WV

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FLOW
OHIO RIVER

SWMU 3
SWMU 2
SWMU 5
SWMU 7
SWMU 8
SWMU 22
SWMU 1
SWMU 9
SWMU 17
SWMU 18
SWMU 10
SWMU 10
SWMU 23
SWMU 27
SWMU 29
SWMU 4
SWMU 10
SWMU 13
SWMU 6
SWMU 11
SWMU 13
SWMU 16
SWMU 13
SWMU 20
SWMU 13
SWMU 24
SWMU 21
SWMU 14
SWMU 13
SWMU 19
SWMU 25
SWMU 26
SWMU 12
SWMU 15
SWMU 28

WV STATE ROUTE NO. 2

SWMU 30

SWMU
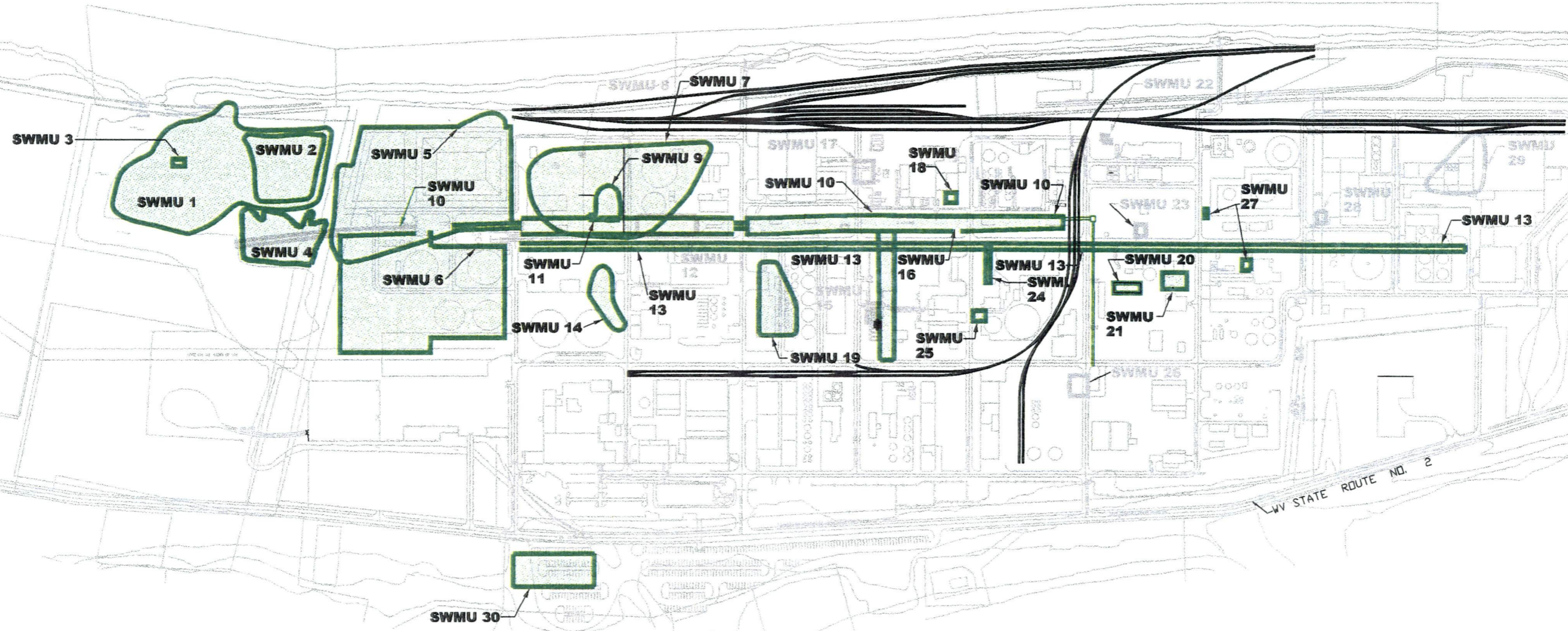
	SWMU	LOCATION
1	South Landfill	South Landfill
2	Sludge Lagoon	South Landfill
3	Fill Area Hydroblasting Station	South Landfill
4	Ash Lagoon	South Landfill
5	Residue Fill Area Unit 3Fc	Equalization Basin/Rainwater Lagoon
6	Residue Fill Area Unit 3Fd	Clarifier and Bioxidation Tanks
7	Fill Materials Block 21	Block 21
8	All Purpose Burning Pit	Block 21
9	Residue Fill Area 3Fe	Block 21
10	Infilled Wastewater Ditch (Former Process Trench)	Throughout Facility
11	Acid Neutralization Facility 5Fg	Block 21
12	Former Neutralization Spill Basin	Block 22
13	Existing Process Trench	Throughout Facility
14	Fill Materials Block II	Block 11
15	Neutralization and Settling Basin 5Fa	Block 14
16	Neutralization Basin 5Fe	Block 24
17	Poly1 Spill	Block 24
18	Lab Area 24A	Block 24
19	Residue Fill Area Unit 3Fa	Block 13
20	Nitrations Neutraliz./Settling Basin 5Fb	Block 16
21	Nitrations Neutraliz./Settling Basin 5Fc	Block 16
22	Vortex Burner	Block 26
23	TDI Area 26B	Block 26
24	Neutralization Trench/Basin 5Fd	Block 15
25	HCl Area 15C	Block 15
26	Former Waste Disposal Incinerator	Block 5
27	Mononitrobenzene	Blocks 17 & 27
28	Iron Oxide Area 28A	Block 28
29	Fill Area Block 28	Block 28
30	Residue Fill Area Unit 3Fb	Parking Lot East of Rt 2

LEGEND

SWMU 7 — SWMU HAVING CONSTITUENTS EXCEEDING RESIDENTIAL RBC

SCALE
0   400   800

IT CORPORATION

BAYER NEW MARTINSVILLE
NEW MARTINSVILLE, WEST VIRGINIA

FIGURE F.4-1
SWMUs HAVING CONSTITUENTS
EXCEEDING RESIDENTIAL RBC
RCRA FACILITY INVESTIGATION